



A University Direct Readout Station and Software Decoder for NOAA POES Real-time Direct Sounder Broadcast on Distinct Frequencies Unrelated to the Widely Received APT VHF Transmissions

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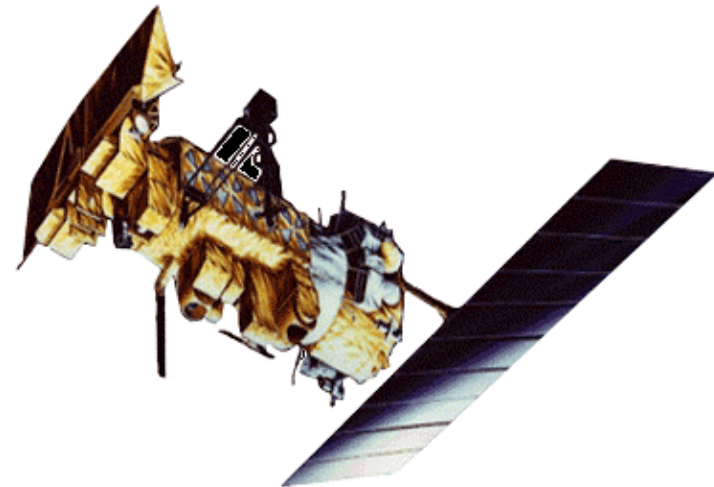
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NOAA Satellite Direct Readout Conference
December 8, 2004

Outline

- Introduction to POES Direct Sounder Broadcast
- Overview of MSU's Direct Readout Station
- DSB Data Format
- MSU's Software Decommutator
- Future Applications



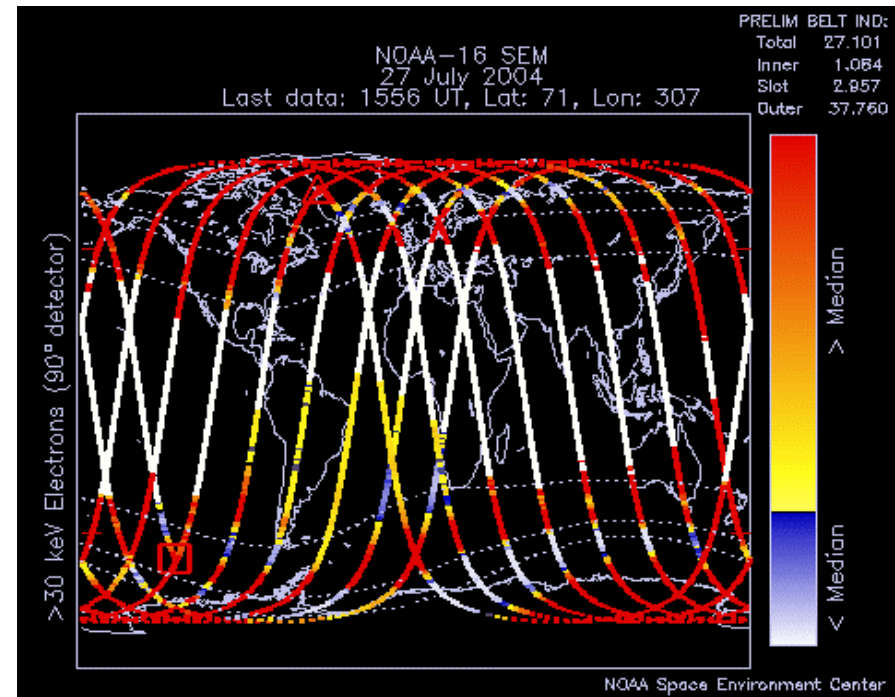
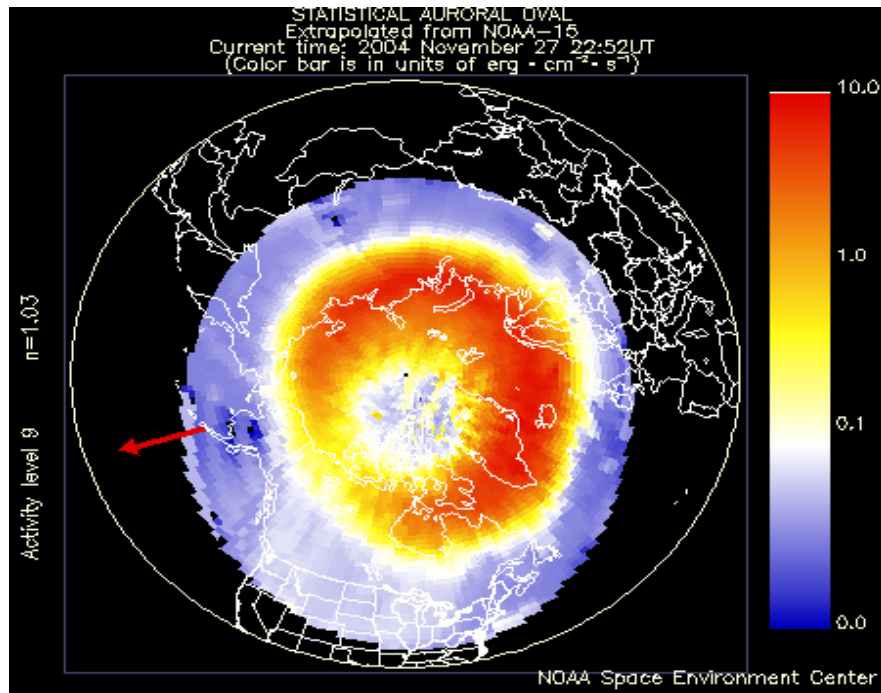


Introduction to POES DSB

(Also known as the Real-Time Beacon Transmitter)

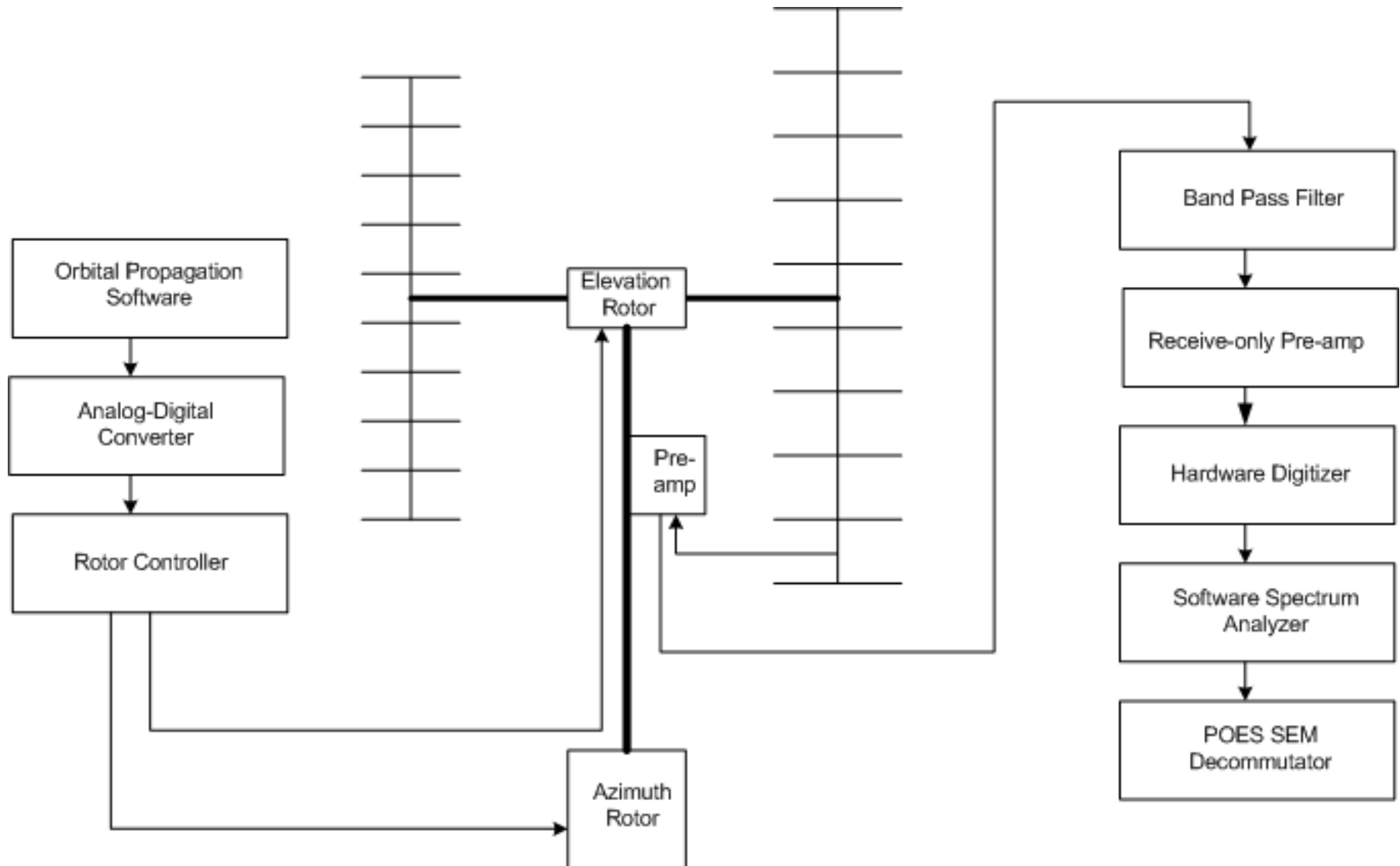
- Real-time data system aboard the NOAA KLM series
- Multiplex of digital/analog housekeeping data & low-rate sensor readings collected onboard
- TIP output transmitted using VHF frequencies (137.35 & 137.77 MHz)
- Quite different from the meteorological images from Automatic Picture Transmission (137.50 and 137.62 MHz)

Charged particle spectrometer measures the intensities and distribution of energetic particle population



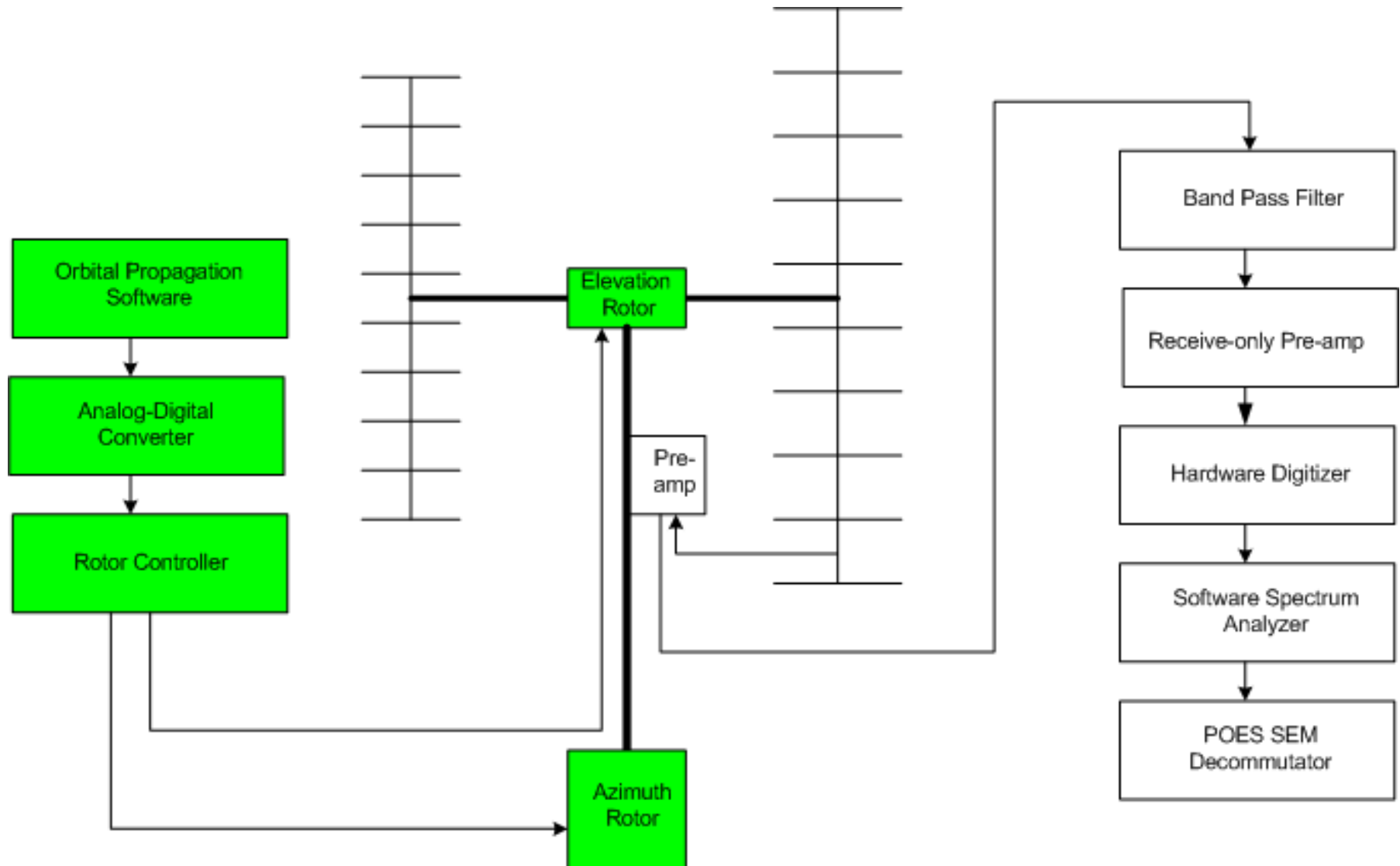
Data are used to study the effects of particles on the near-Earth space environment

POES Direct Readout Station



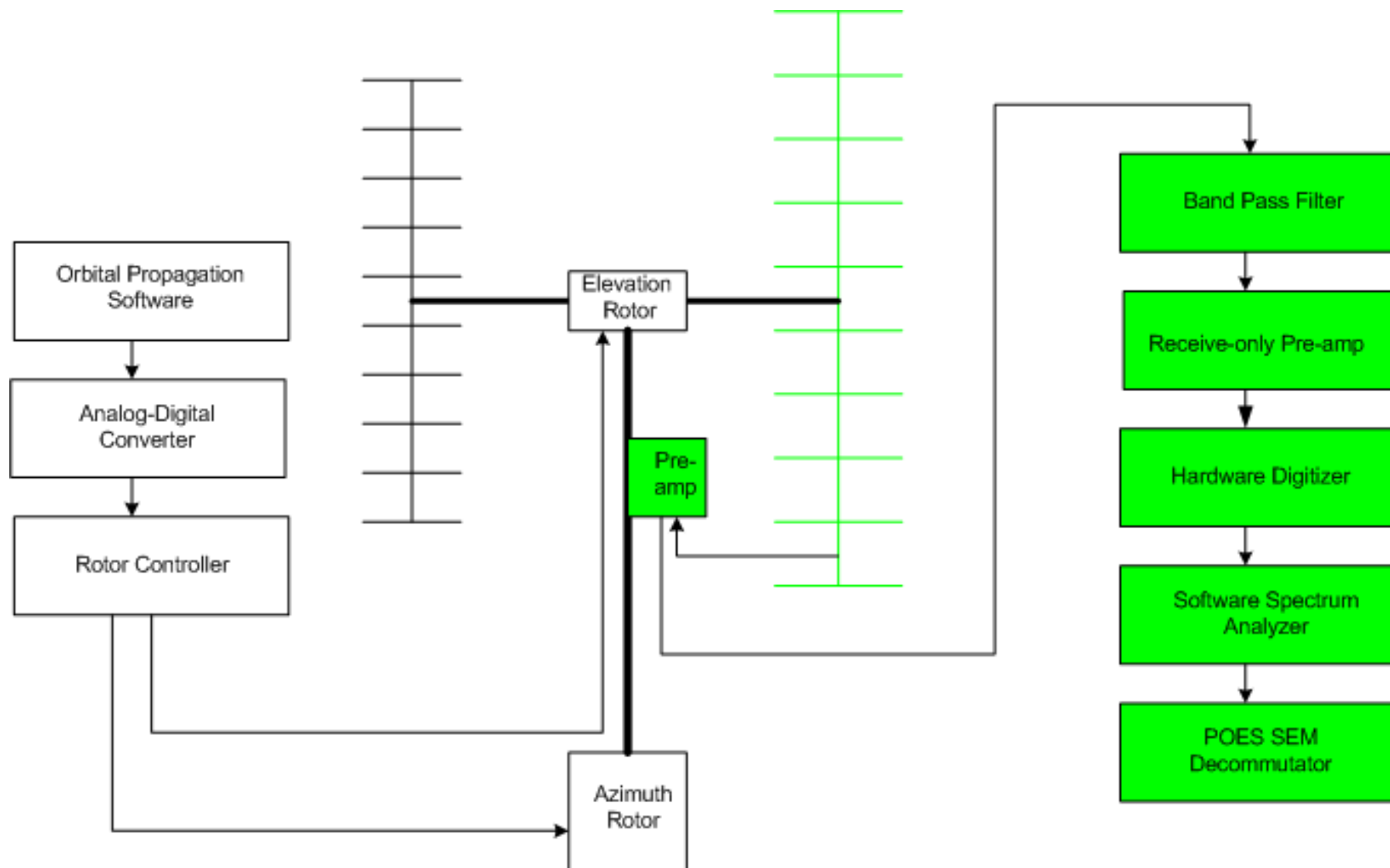


Antenna and Rotor System





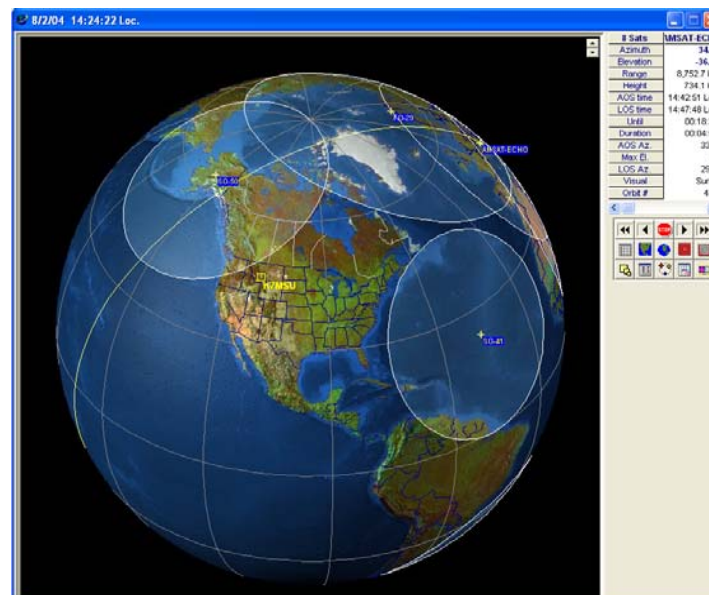
Receiving Equipment



Antenna and Rotor System



M² Antenna and Icom Preamp

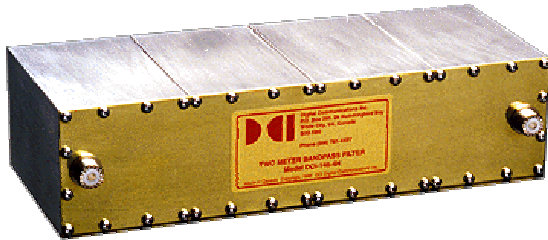


Nova for Windows



Yaesu G-5500 Rotator

Receiving Equipment

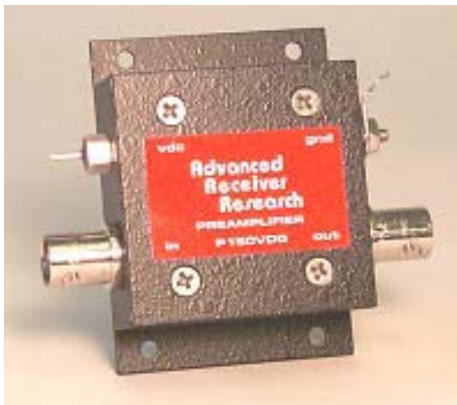


DCI Bandpass Filter

Analog filter and preamp
used to reduce bandwidth
of POES transmissions

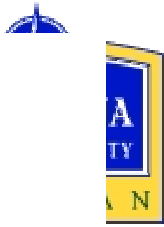


RF Space SDR-14



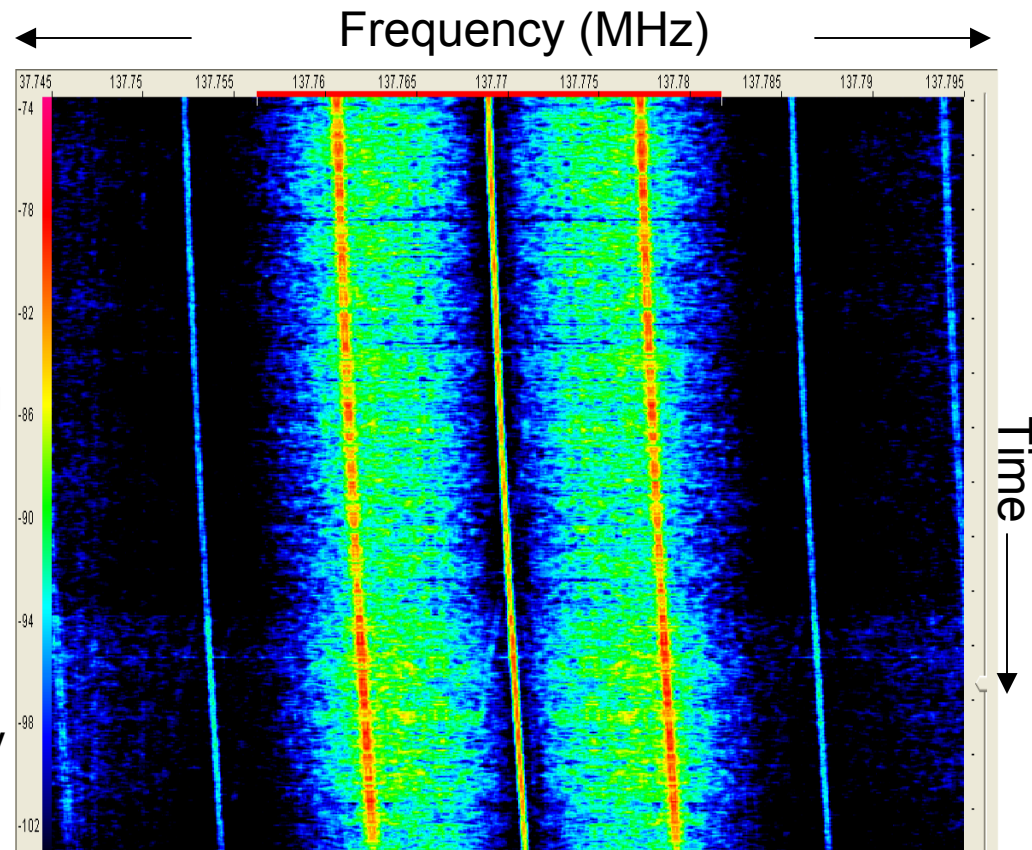
AAR Receive-only Pre-Amp

Hardware digitizer samples RF
signal, performs base-band
conversion, and sends output
over USB interface to PC



Software Spectrum Analyzer

- Performs real-time frequency domain analysis
- Has low-level demodulator module
- Image:
- 150 Hz spectral scan near transmitting frequency
- Shows numerous side bands generated during modulation process
- Slanted appearance reveals frequency drift due to Doppler shift
- Demodulated signal saved @ 48 kHz



Moetronix SpectraVue

Amplitude (dB) (Color Coded)





Modulation & Data Format

Modulation: Digital Split-Phase

+/- 67 phase shift \rightarrow Digital “1”

-/+ 67 phase shift \rightarrow Digital “0”

Data Rate:

8320 bits per seconds

Frame Format:

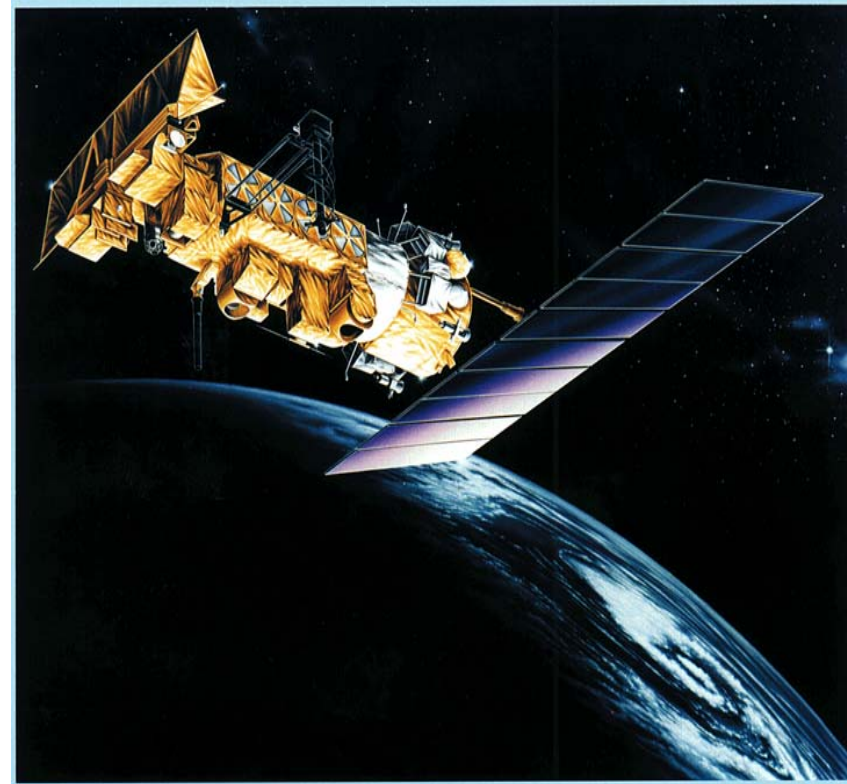
1 major frame every 32 seconds

1 complete data packet per major frame

320 minor frames/major frame

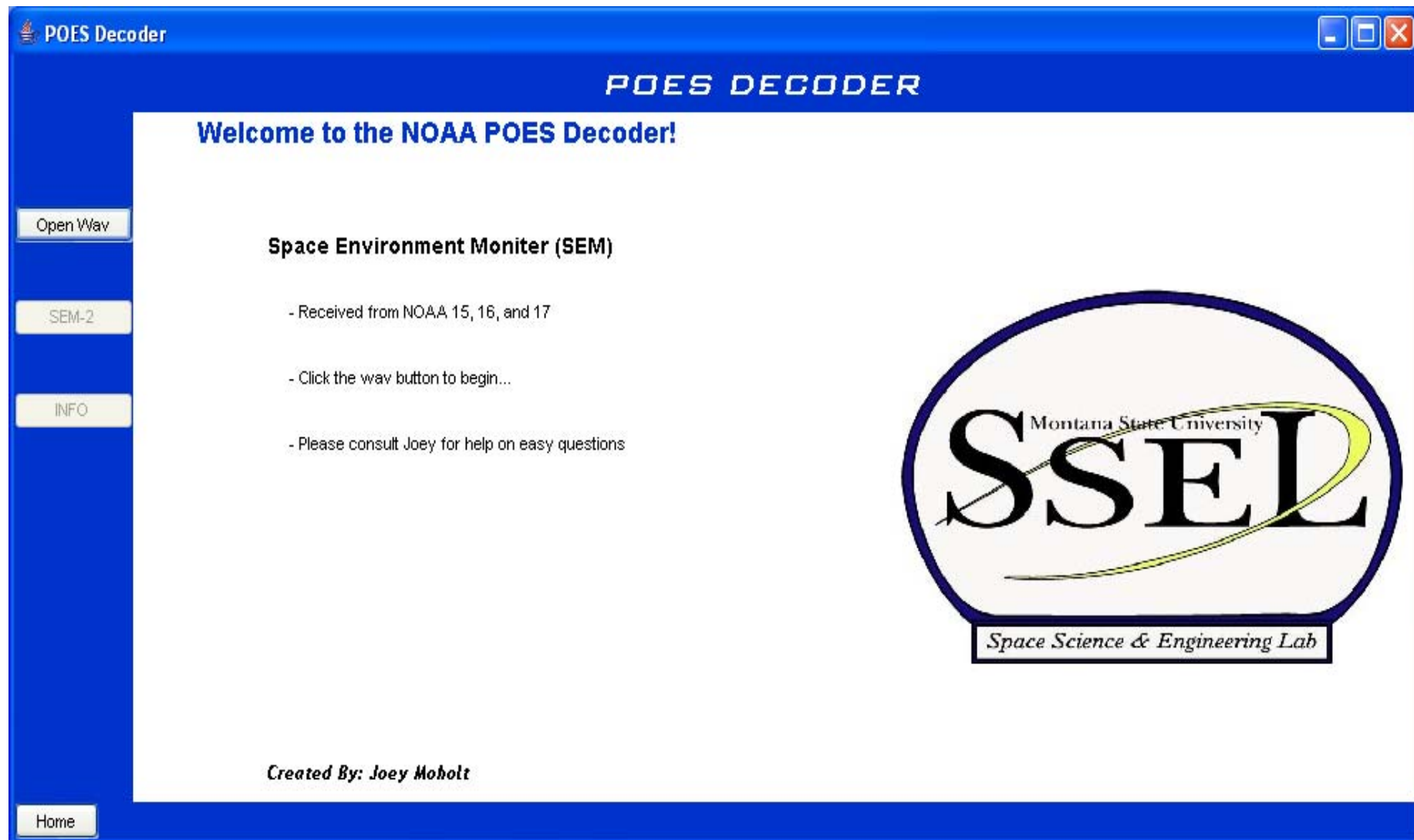
SEM Data Format:

Two 8-bit words/minor frame



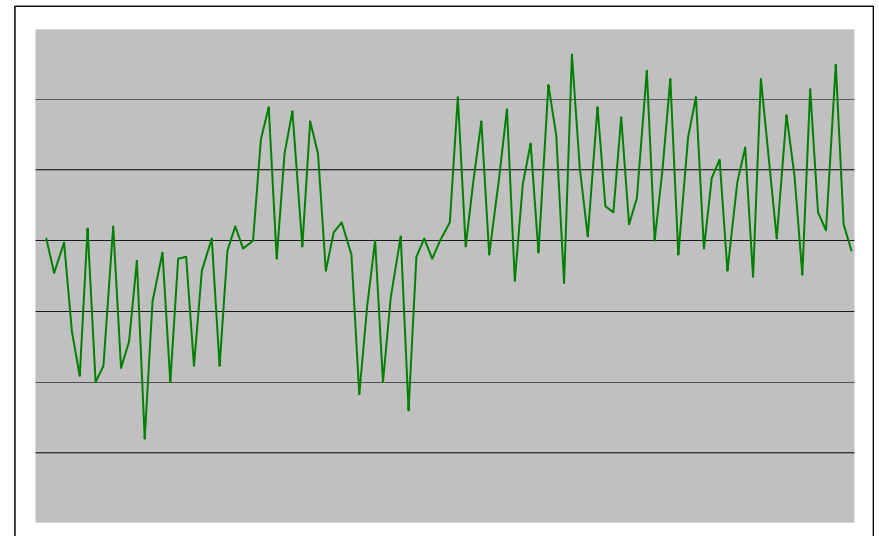
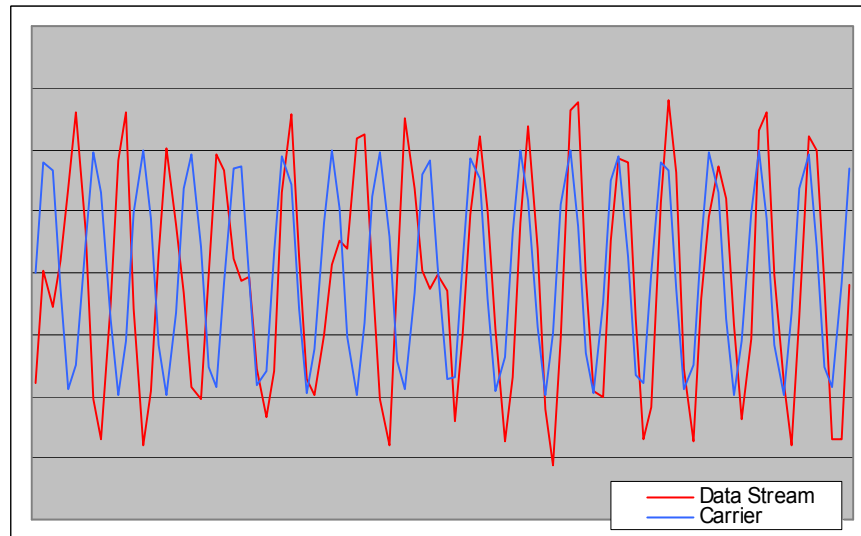
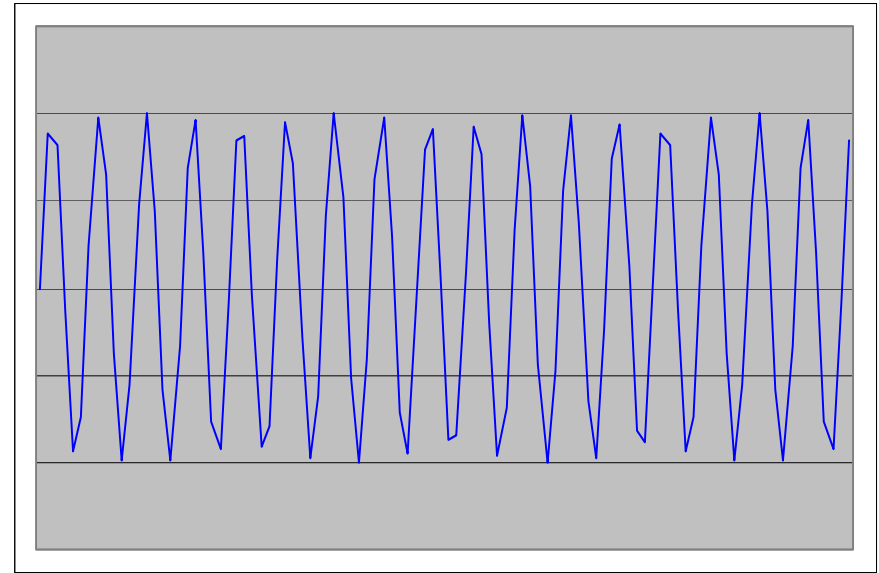
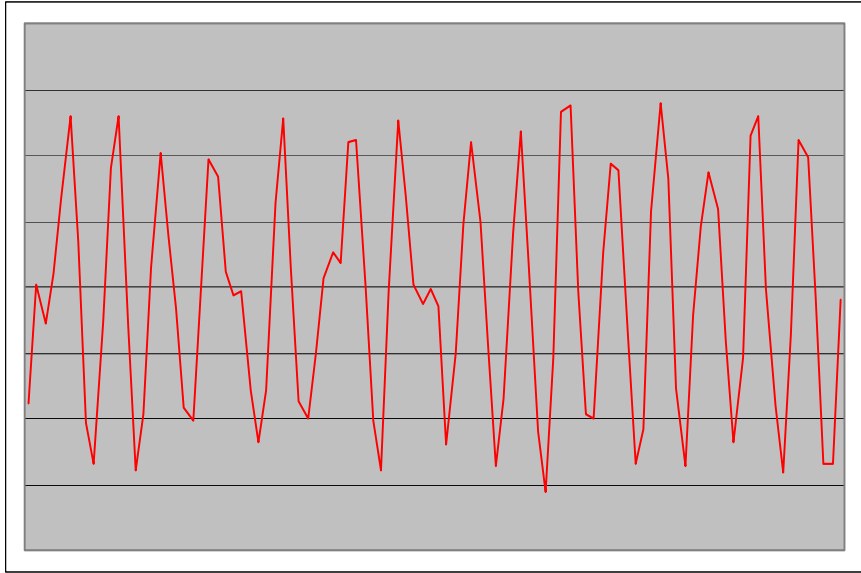


Software Decommutator

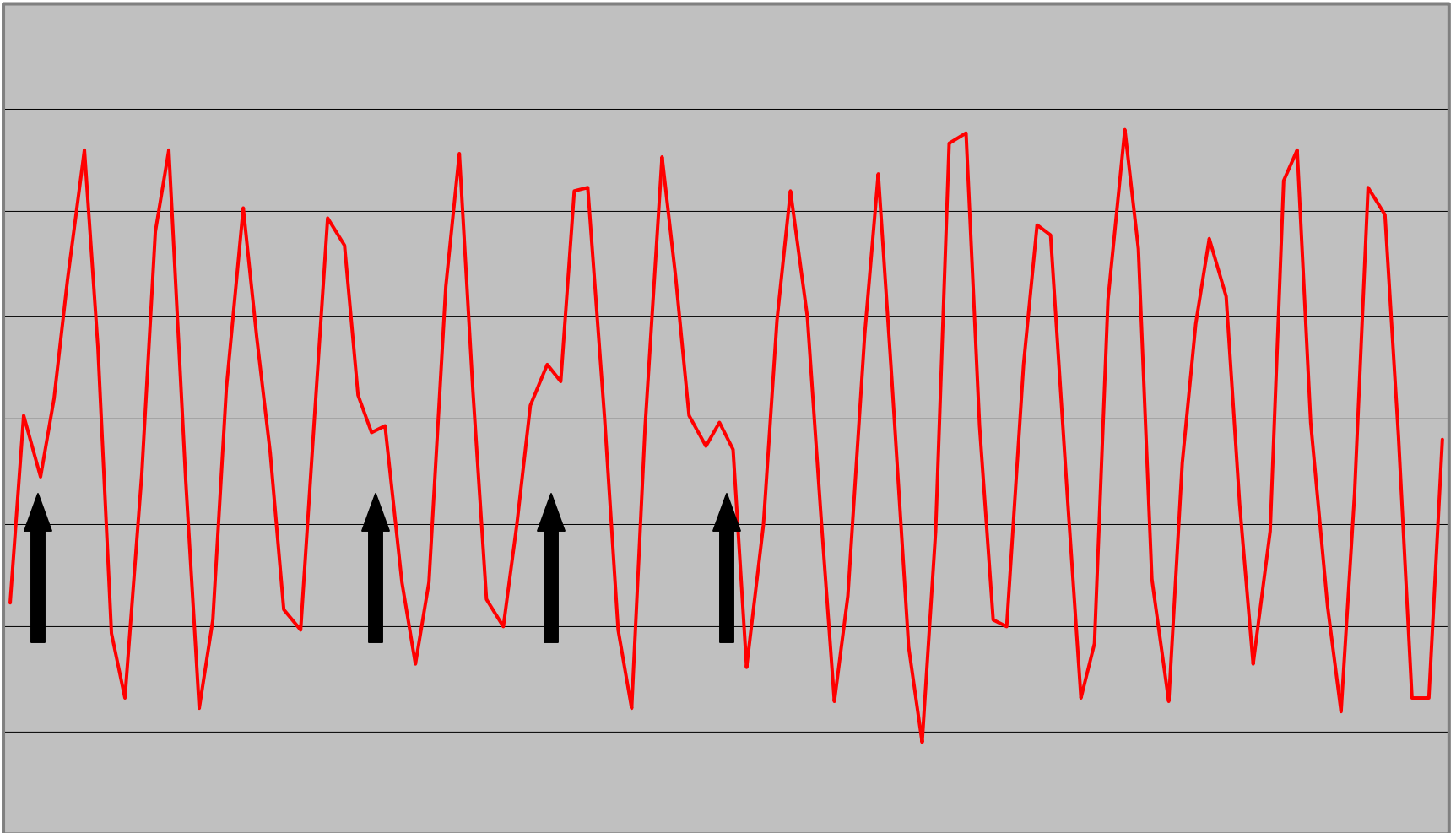




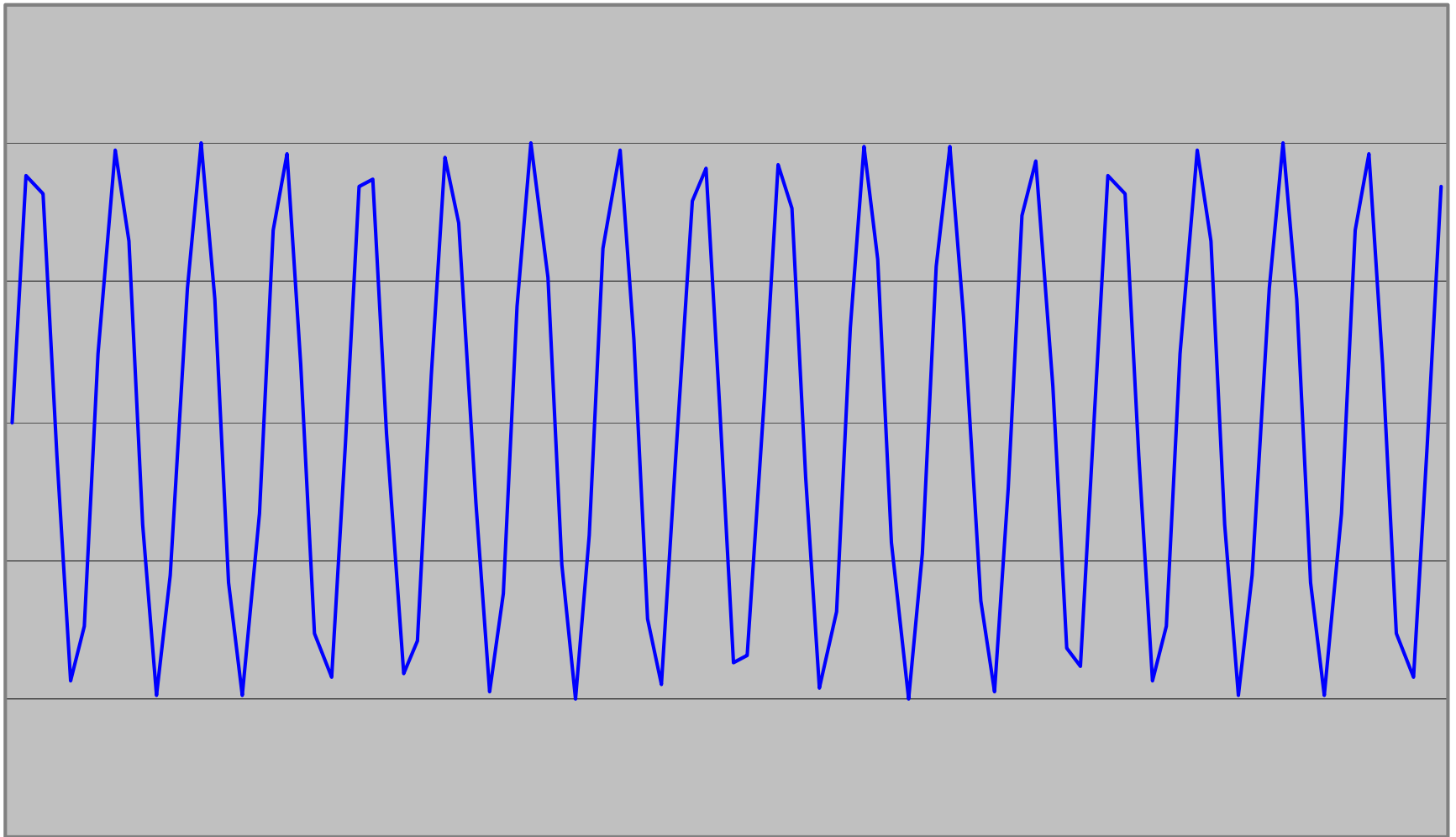
Demodulation Technique



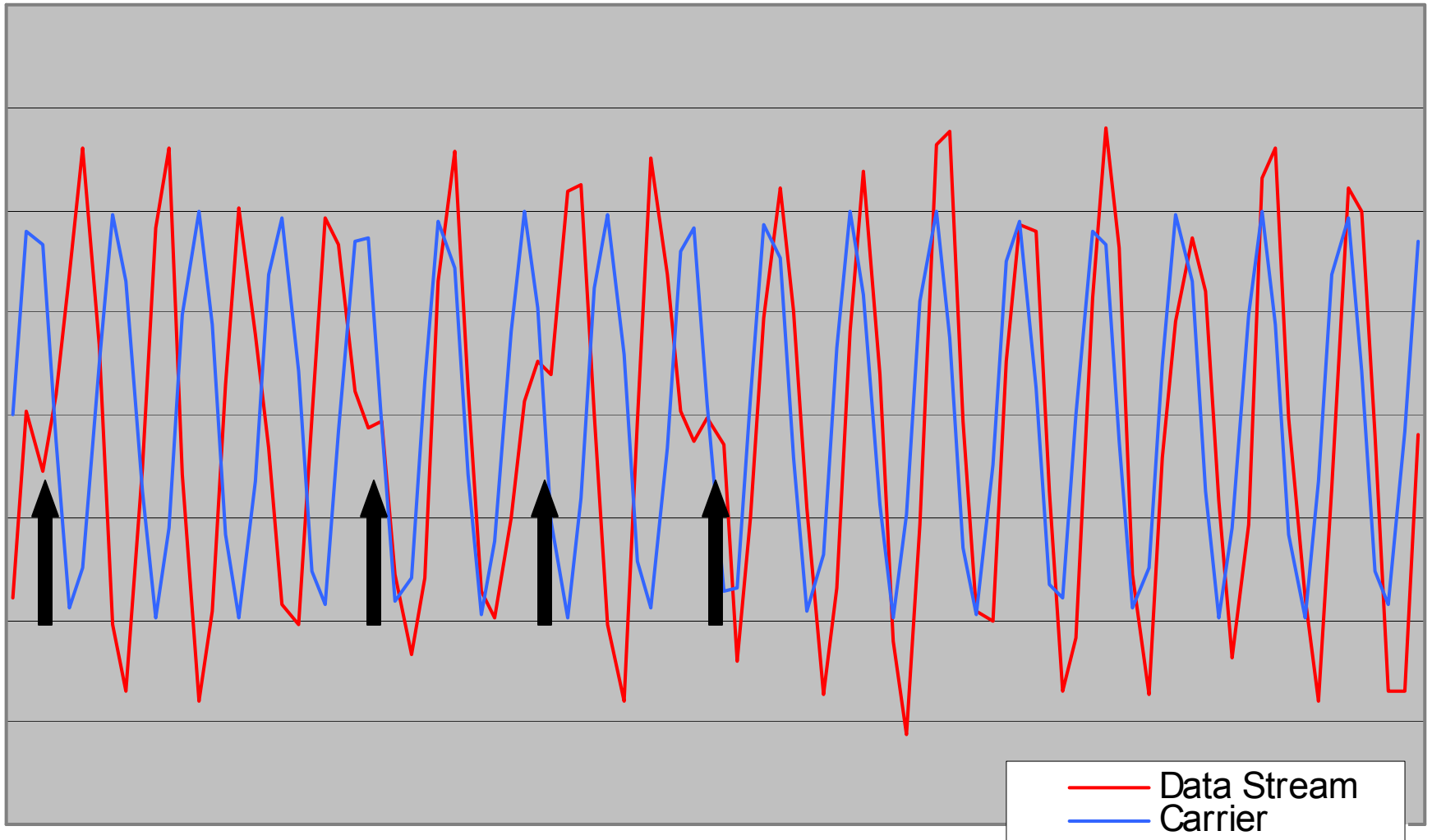
Incoming Data Stream



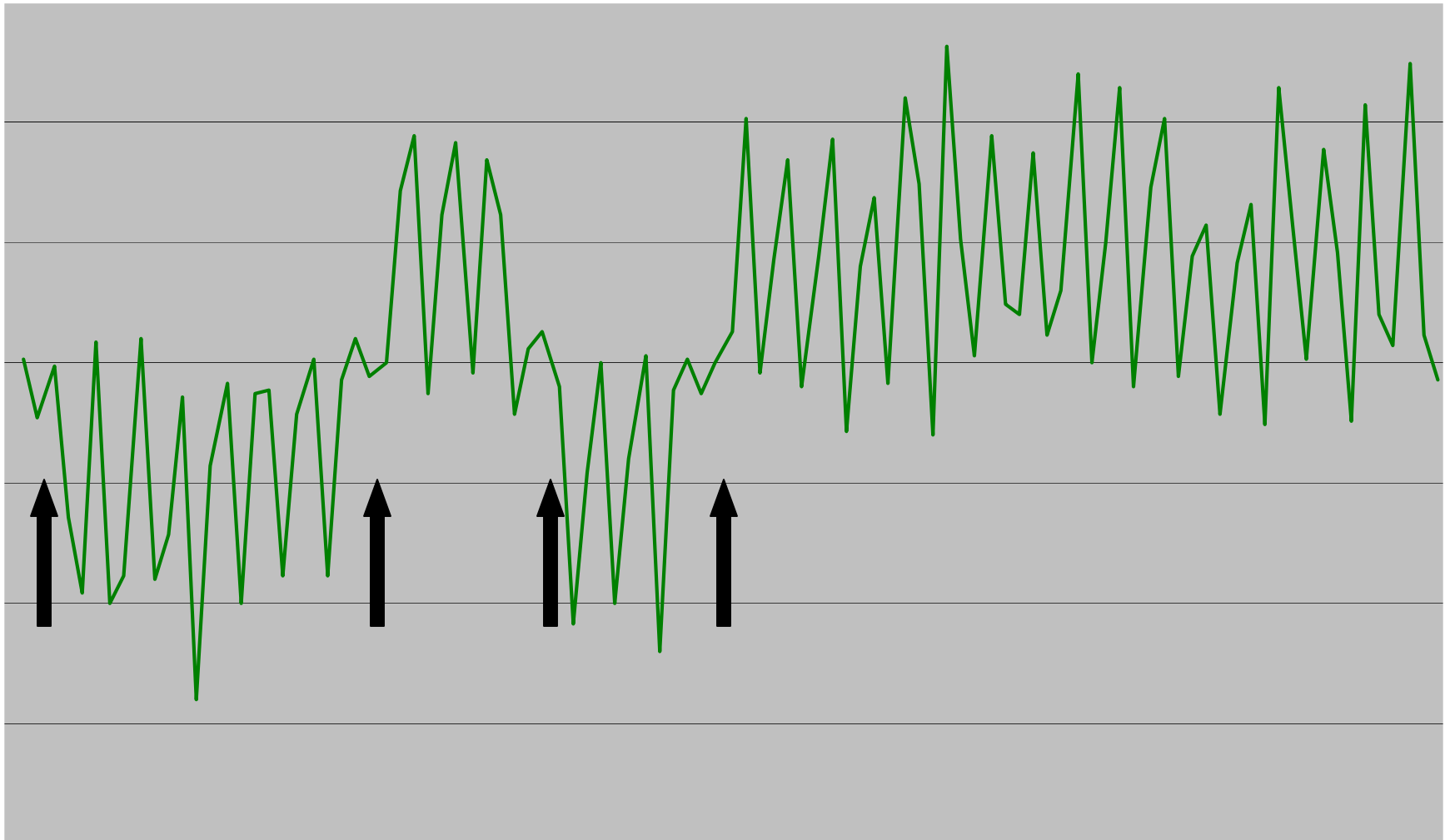
Generated Carrier

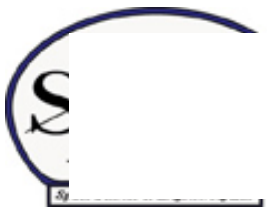


Signal Overlay

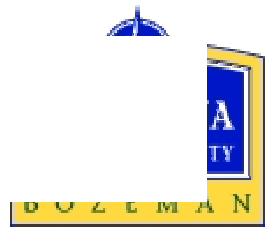


Signal Multiplication

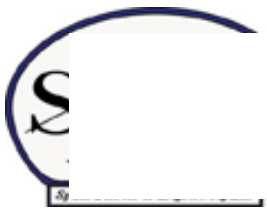




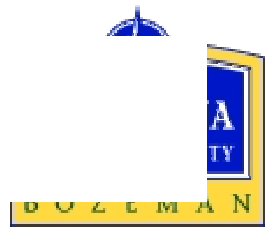
Data Parsing



- Lock onto minor frame synchronization bits
- Locate minor frame counter
- Identify satellite ephemeris data
- Identify two SEM words in bit pattern
- Generate visual plots if needed (counts/sec vs. time)



What are the Benefits?



Current System:

- All data is received by NOAA CDA Stations
- In some cases most current data is hours old

Proposed System:

- Able to report real-time variations in the near-Earth particle environment
- Provide up to the minute observations during major magnetospheric events



Education for Ground Station Personnel



POES Characteristics

BTX Power:	1 watt
Data Rate:	8.32 Kbps
Antenna Polarization:	Linear



Orbit:	Sun Synchronous
Inclination:	98.7°
Altitude:	812 km
Period:	101 min



Other DSB Data Products

High Resolution Infrared Radiation Scanner

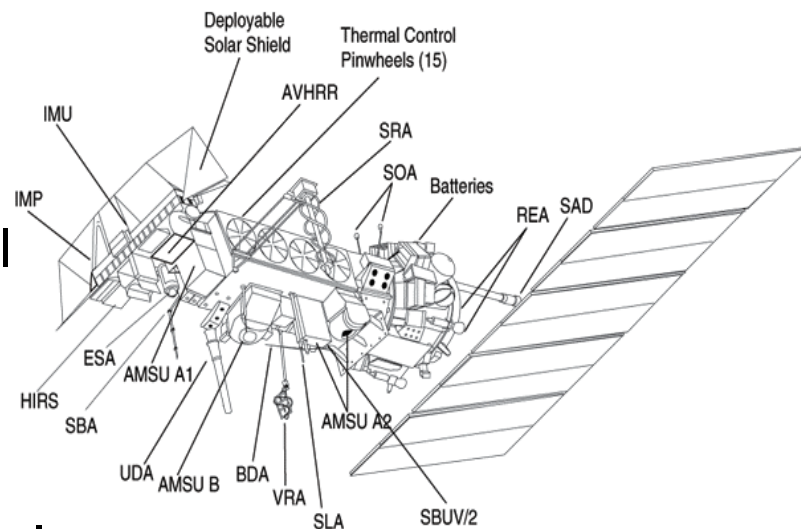
- Provides vertical temperature profile

Data Collection System

- Receives data from remote environmental platforms

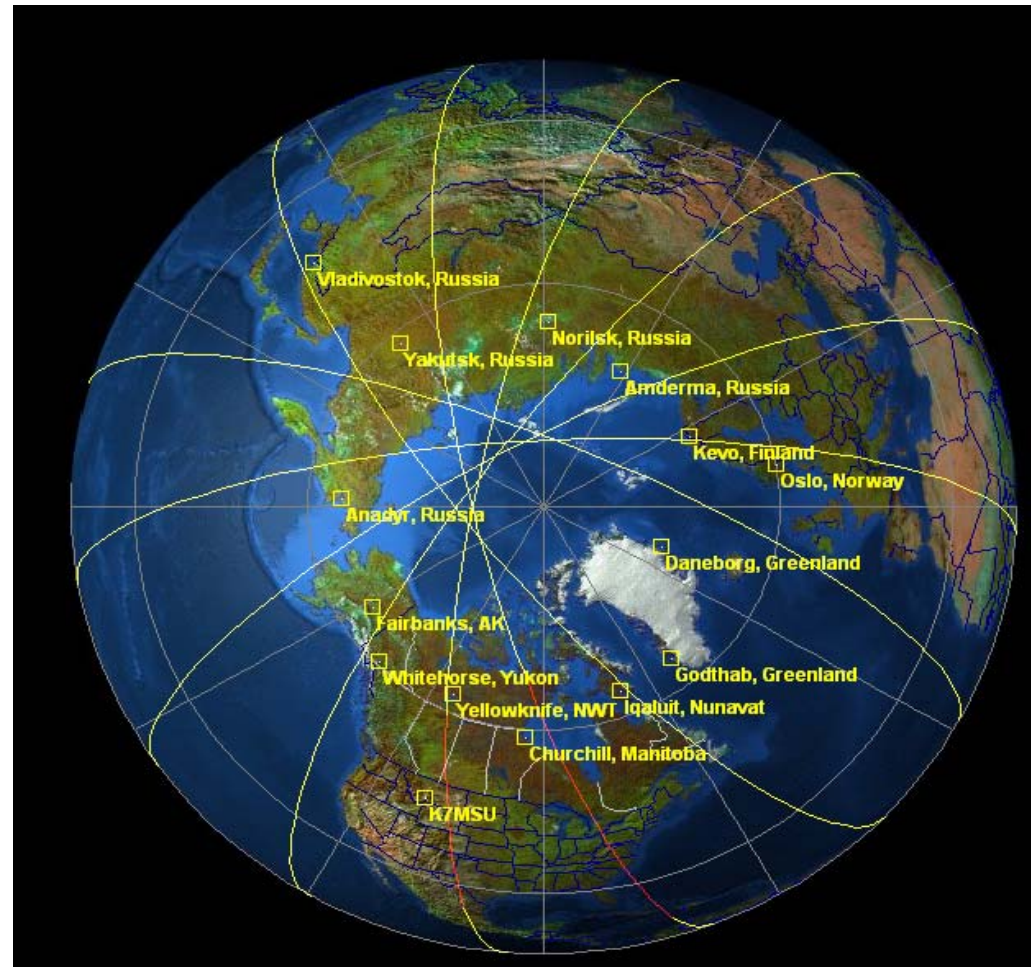
Solar Backscatter Ultraviolet Spectral Radiometer

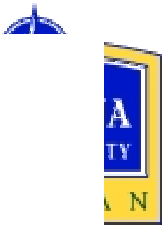
- Measures the Solar irradiance and Earth radiance



Global Partnership of Direct Readout Stations

- Provide global up-to-the-minute space environment data
- Target polar regions and south Atlantic
- Establish on-line database to deposit data
- Create dynamic website to access most current particle data





Acknowledgements

Dr. Dave Evans

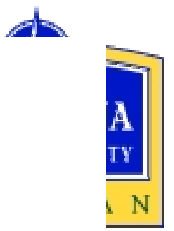
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Questions?



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